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Motivational Elements of the Human Factor for the Implementation of the “Vision Zero” Concept in Railway Transport

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Abstract

The paper is devoted to expanding the composition of the studied elements of the human factor that affect the level of industrial injuries. The significant achievements of JSC “Russian Railways” are shown in reducing injuries and the tasks of implementing the “Vision Zero” concept, which can be solved if additional reserves are attracted. The purpose of the paper is to widely include motivational elements in the human factor, which allow approaching the implementation of the concept of zero injuries. An overview of the studied factors of injuries in the industry is given. Based on the conducted research, motivational elements that have an impact on the safety of production processes are identified. The use of the SHELL concept allowed approaching the systematic study of the problem of injury minimization based on the study of the relationship between a person and the organization’s resources. Problematic behavioral characteristics of industry employees and ways to solve them are identified. Obtaining an objective picture of the real state of the motivational sphere is possible by using a comprehensive approach with the involvement of additional research results. Research methods: expert, sociological survey, statistical data analysis, comparison, system analysis. As a result, the following conclusions are obtained: the construction of an industry system of personnel motivation in relation to reducing the level of industrial injuries requires the use of research results on the motivational sphere of employees. These results will allow implementing a comprehensive approach, making additions to the mechanisms of management actions to reduce injuries.

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1. Introduction

The relevance of the research topic is due to Russia's joining the international information movement "Vision Zero" in 2017 at the initiative of the Ministry of labor and social protection of the Russian Federation, which requires finding new reserves as demonstrated (Zwetsloot et al, 2017). The document of JSC "Russian Railways" 2019 "On approval of the Program of Measures for the Implementation of the Vision Zero Concept notes the focus of this program on the prevention and reduction of industrial injuries and occupational diseases, the formation of a corporate culture of labor safety. The basic principles of the program are the following: priority of the employee's life and health; responsibility of managers and each employee for safety and compliance with all mandatory labor protection requirements; involvement of employees in ensuring safe conditions and labor protection; assessment and management of risks in the workplace, conducting regular safety audits. The "Golden rules" of the "Vision Zero" concept set out in Table 1 are specified for the railway industry, and these tasks are classified according to the objects of managerial influence in the organization and can be taken as the basis for the formation of new areas of injury minimization.

Table 1. Seven "Golden rules" of production with zero injuries and safe working conditions in JSC "Russian Railways".

No	The rule of the concept of "Vision Zero"	Tasks of JSC "Russian Railways" in the field of labor protection
1	To become a leader – to show commitment to the principles	Education of the corporate culture of labor safety, responsible attitude to the health of employees
2	To identify threats - to control risks	Reducing potential health and safety risks
3	To define goals – to develop programs	Improving the effectiveness of preventive measures to comply with the requirements of labor protection standards
4	To create a system of labor safety and health – to achieve a high level of organization	Improving the management system in the field of labor protection
5	To ensure labor safety and health in the workplace when working with machines and equipment	Ensuring compliance of labor protection activities with the current level of science and technology development
6	To improve workers' skills - to develop professional skills	Improving the level of training personnel on labor protection issues
7	To invest in human resources - to motivate through participation	Ensuring, developing and stimulating personal and collective responsibility of employees of the "Russian Railways" holding for compliance with labor protection requirements

2. Methods of the Research

To assess the current state of injuries in the railway industry, we will look at the statistics. The general characteristic of industrial injuries can be summarized as a significant reduction in the level of injuries in the industry over 15 years as a result of purposeful activities of JSC "Russian Railways": general industrial injuries – by 6.7 times, and fatal injuries – by 7 times (1123/146 in 2003; 168/21 in 2018). The results of significant positive changes over the past 5 years are shown in figure 1. With the achieved low level of injuries in the base period, the current task of nullifying it will require new management solutions for its implementation.

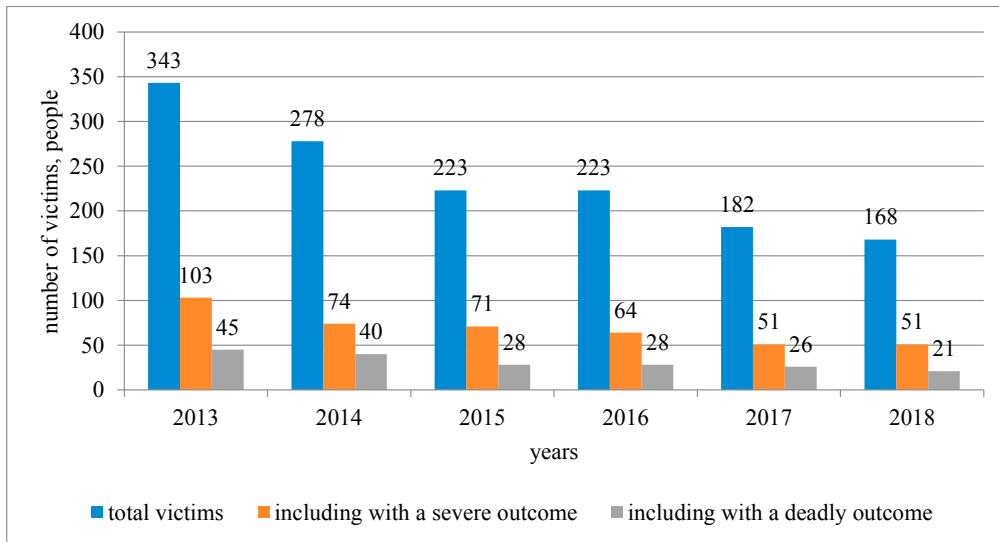


Fig. 1. Dynamics of the level of industrial injuries in JSC "Russian Railways.

Numerous studies show that 70-80% of all accidents are caused by workmen or people around them as a result of their erroneous actions as demonstrated (Lam and Tai, 2020, Li et al., 2019a, Liu et al., 2019b, Nielsen et al., 2019). To form the structure of employees involved and the causes of injuries, we will turn to different sources. Used in the industry "Methods of evaluation of human factor influence on the occurrence of the accident..." allowed us to determine the overall structure of the victims and relevant to the injury workers: 31% of the victims – performers, 21 % – their supervisors, 20% linear leaders of the enterprise, 15% – other performers (figure 2).

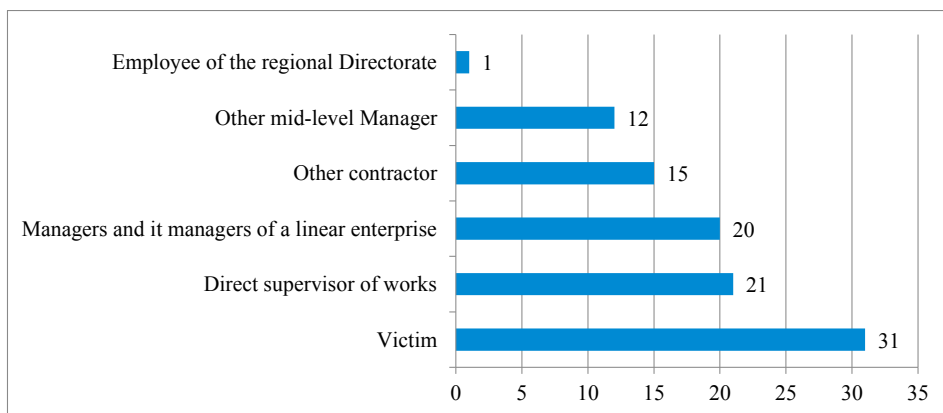


Fig. 2. Distribution of employees involved in the occurrence of injuries at work, %.

Based on the use of the materials of the above-mentioned methodology, the main causes of human violations of labor protection requirements are identified: motivational, indicative and executive features of actions. Deviations from the norms of behavior for motivational reasons are associated with the fact that the employee does not always comply with the rules of labor protection, since employee does not consider it necessary to do so (for example, compliance with the rules may affect its development, the duration of the task and, as a result, the salary). The reasons for the indicative part of the actions are due to lack of knowledge of the characteristics of behavior in a dangerous situation (poorly knows the rules of labor protection, does not have the necessary information). Executive

reasons for actions are due to the inability to meet the requirements of labor protection due to mental and physical capabilities of the person (stress, poor health).

The materials of the IV forum “Prevention of the “human factor” in the work of the staff of the Sverdlovsk railway” from 14.06.2019 show the problem category of employees, which includes the block of personnel “D. Does not want to” (figure 3), which has such behavioral characteristics as laziness, nihilism, indiscipline, need for adrenaline, which indicate their low internal motivation.

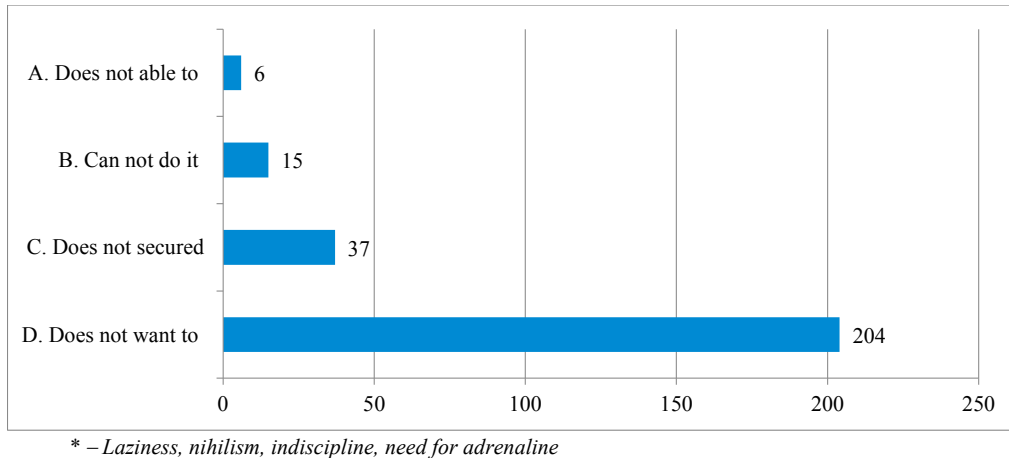


Fig. 3. Influence of the “human factor” when performing dangerous actions by employees. (* - Laziness, nihilism, indiscipline, need for adrenaline).

The above materials indicate the need to focus on the causes of insufficient internal motivation of some employees, which has a significant impact on injuries. The previously obtained results of the influence of various elements of the human factor on compliance with labor protection standards do not exhaust all possible components that affect human behavior in the workplace, and require further differentiation in research, establishing causal relationships of phenomena that allow us to identify new dependencies for a deeper specification of the causes of injuries. As a result, the task is to determine additional factors that cause injuries and affect labor safety based on a systematic analysis of the causes of industrial injuries in railway transport.

3. Results of the Research

Successful implementation of the planned zero-injury program can be achieved by using a systematic approach that allows us to identify relationships of factors, some of which have not yet been taken into account. Currently, the analysis of the causes and characteristics of accidents on the railway is performed by specialists from different countries using modern research methods.

The order of JSC “Russian Railways” No 2068p of September 21, 2011 approved the standard “Human factors in the traffic safety management system” (as part of the general document “On approval of standards and techniques of JSC “Russian Railways” in the development of the traffic safety management system based on risk analysis, methods and tools of technical audit”), which refers to the SHELL conceptual model used in the International civil aviation organization as demonstrated (Molloy and O’Boyle, 2005). The general approach proposed in it provides a basis for searching for new connections between elements of the external and internal environment of an organization and a person.

The analysis of existing concepts of strategic analysis used in the study of multidimensional problems of the organization allowed us to identify the “SHELL” model, formed on the principle of interaction of resources (“directed policy matrix”), to determine the fundamental relationships of system-forming factors. We will take it as a basis for forming the most complete composition of elements, which is based on their state and interaction (figure 4). This model allows us to generalize the relationship of an employee with elements of the external and internal environment of the organization.

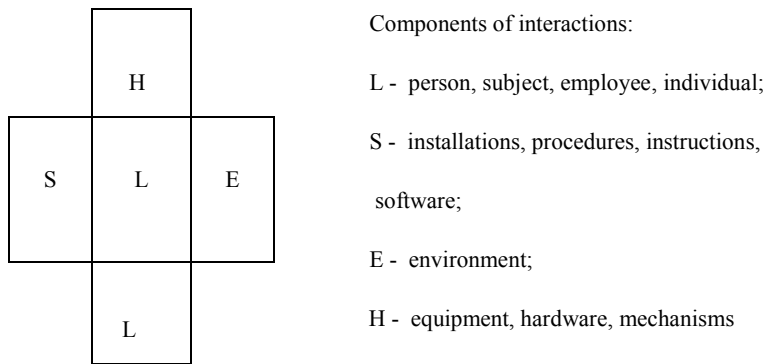


Fig. 4. Composition and relationship of elements of the “SHELL” model.

At the center of the system is a person (L) - a participant in the production process, in relation to which all relationships are built.

Using a rigid “subject-subject” relationship (L-L), we display the relationship between an individual and other people in the workplace, including the chief as demonstrated (Kiss, 2005; Yu et al, 2018). On the basis of interface “subject – equipment” (L-H), we represent the employee’s relationship with the equipment. On the basis of “subject – procedure” relationship (L-S), we reflect the relationship between the individual and the support systems available in the workplace, which include rules, guidelines, checklists, regulations, software, etc.

Using the “subject – environment” interface (L-E), we display the individual’s relationship with the internal and external environment as demonstrated (Dembe et al., 2005; Dembe et al., 2008; Larue et al., 2019). The internal environment is directly related to the organization of the workplace, the level of temperature, lighting, background noise, etc. The concept of the external environment includes not only the physical environment outside the workplace, but also a wide range of strategic and economic conditions for the functioning of the organization and the country.

This structuring of factors once again emphasizes the versatility of the object of research, considering a person in the process of work not only in interaction with objects and tools, internal and external environment, but also a very significant impact of one person on another as demonstrated (Porru et al., 2017).

We will analyze the development of these links that affect injuries in the railway industry. Appeal to literary sources, in particular, methodological materials of JSC “Russian Railways”, on the human factor, leads to the conclusion that the relations of the system elements (“subject-equipment” and “subject-procedure”) is a well-described by experts on labor protection. Violations are recorded in these areas and appropriate actions are formed.

As for the “subject – environment” relationship, the conducted analysis of the identified dependencies allow us to note that internal environment, including work space, temperature, lighting, background noise, etc., collectively represented by the concept of “working conditions” is also quite well represented in the industry and has been thoroughly researched.

However, a significant area of the internal environment, which has a significant impact on the state of the human factor in the work environment, was not reflected in the research. It includes elements that are studied in management and personnel management: the corporate culture of the enterprise, the system of awareness of team members, management principles, involvement of employees in decision-making, personnel policy, workplace organization, regulation of working hours, the amount of information available to staff, the principles of employee

evaluation, the motivation system and the content of the social package, etc. Research in this area, conducted by specialists in various areas of human studies in the production environment, shows a significant impact of the complex of these aspects on the level of behavioral characteristics of employees, depending on the level of their internal motivation.

Establishing reasoned approaches to the study of internal motivation requires research of social and labor relations and behavioral characteristics of various categories of employees. The examination of the actual state of motivation of the individual is possible only on the basis of a comprehensive study using additional factors, for example, are covered in foreign press as demonstrated (Guo et al., 2019). So, the achievement of economic results, especially in relation to the person as multidimensional and variable labor resource, is possible on the basis of his deep study. Using the findings of modern research will expand the composition of the causes of injuries in the study of the human factor. The interaction of people – social and economic aspects of the internal and external environment of the organization in terms of reducing injuries has not been sufficiently studied.

Considering the concept of “SHELL”, which we have taken as the basis for the systematization of factors, it should be noted that it provides a representation of elements in statics. But during periods of significant transformations, it becomes important to consider them in dynamics, when a change in one element of the system affects the essence of interaction phenomena. As an argument for this approach, we will give the following example: in 1991, in our country, there have been significant changes in the political and economic system, which led to the transition from paternalism, as a fundamental characteristic of social and labor relations, inherent in the previous system, to subsidiarity, which assumes the responsibility of citizens for their well-being while respecting the interests of the parties. Such transformations of living conditions have a significant impact on the level of motivation and should be taken into account in the formation of managerial influences. Adaptation of all residents of the country to modern living conditions and staff to labor relations at work is slow and requires management decisions to smooth out negative phenomena.

The above arguments allow us to draw a conclusion about the need for a broader interpretation of the concept of “human factor” as a cause of industrial injuries, which requires additional research on the phenomenon of motivation of employees at all levels in terms of its impact on compliance with labor protection requirements. For example, the phenomenon of motivation can not be limited only to material or moral punishment of the employee (loss of bonuses or social benefits in case of violation of labor protection standards). When using this mechanism of influence, it is assumed that every employee will be under the same influence in the course of their work, which should lead to the desire to meet the requirements of labor protection. However, in practice, the response of staff varies. No less important is the targeted selection of employees when hiring. In case of ignoring a more complete study of the motivational sphere of the candidate for the workplace at the initial stage of work, in the future, staff opportunism may lead to non-compliance with labor protection standards on the part of both managers and employees. The next argument is in favor of additional research: the motivation systems used in practice assume uniform methods of influencing all employees. Lack of the knowledge of the employee’s motivational profile leads to the use of a standard mechanism of motivational influence (not adapted to his type of motivation), which does not bring the expected results.

As an initial stage of problem solving, the following set of studies is proposed, adapted to the current motivational state of employees in the industry. We will present the results of our survey (Parshina et al., 2017) of industry leaders. To identify the motivational profile of managers, we conducted surveys using a well-known methodology to identify the main motives for work as demonstrated (Howard et al., 2016). The method offers determination of the level of internal, external positive and external negative motivation. Ideally, the ratio of elements of the motivational complex is as follows: internal motivation > external positive motivation > external negative motivation. That is, the level of internal motivation of a person should be higher than the level of influence on person. Table 2 shows the values of the main motives for the work of managers.

Table 2. The main motives for the work of managers.

Types of motives of managers	Average score in group 1	Average score in group 2	Average score in group 3	Average score	Rank the importance of the motive
Satisfaction from the process and result of work	4.63	4.25	4.33	4.40	1
Material reward	4.25	4.06	4.05	4.12	2
Possibility of the most complete self-realization in this activity	3.94	4.19	4.05	4.06	3
The need to achieve social prestige and respect from others	3.56	4.25	4.00	3.94	4
The desire to avoid criticism from the Chief or colleagues	3.38	4.06	3.78	3.74	5
The desire to avoid possible punishment or trouble	3.13	3.94	3.50	3.52	6
Striving for promotion at work	3.25	3.56	3.22	3.34	7

The results of this study also allowed us to conclude that about half (40-60%, depending on the group of listeners) of railway industry managers in terms of motivation fit into the ideal ratio of elements of the motivational complex (internal motivation > internal positive motivation > internal negative motivation), which indicates a good overall motivational potential of managers, balanced with the motivational impact of the administration. However, for 5-10% of respondents, this ratio is unfavorable relative to the production sphere (internal negative motivation > internal positive motivation > internal motivation), which indicates the state of employees “Does not want to” (figure 3). Identifying this contingent of managers is very important when developing measures to reduce injuries. Summing up this research, it should be noted that negative motives (the threat of punishment) that force an employee to comply with the requirements of labor protection standards do not bring significant results. At the same time, positive motives are preferable and their influence is more pronounced. The results obtained allow us to conclude that it is necessary to expand the use of positive motivation tools. After determining the priority motives for managers’ work, it is necessary to conduct a creative rethinking of the existing system of motivation in relation to the needs of specific groups of employees.

Next, we will present a methodology that allows us to adapt the system of external motivation to the state of internal motivation of the staff. To solve these tasks, we will evaluate the types of work motivation using well-known tests. Evaluating the types of work motivation allows us to determine the internal orientation of respondents in respect of compliance with labor protection standards. Research is conducted based on the theoretical position that there are two main forms of motivation that cause certain motivational influences:

- Achievable - work for an employee is a way to achieve some goals or get some benefits;
- Avoidant (underclass) - the prevailing desire of the employee to avoid punishment or other trouble. Representatives of this form of motivation should be identified at the recruitment stage, since the forecast of their actions in respect of compliance with labor standards is unfavorable.

During the deep research of achievable motivation identifies the following types of employee motivation:

- Instrumental - the work itself is not a significant value for the employee, but only as a source of earnings and other benefits;
- Master – voluntary acceptance of full responsibility for the work performed; the employee strives for autonomy and not only does not need orders and control, but also does not tolerate them;
- Professional - the employee values the content of the work, the opportunity to prove himself and prove that he can cope with a difficult task;
- Patriotic - based on high moral, religious or ideological considerations, the belief in their need for the company; such an employee most values the effectiveness of the common cause and public recognition, expressed more in moral than in material signs.

Here are the types and forms of personnel motivation relative to the currently prevailing types of motivation – instrumental and master (table 3).

Table 3. Recommendations for motivating employees with different types of internal motivation.

Types and forms of personnel motivation	Types of motivation	
	Instrumental	Master
Negative (punishments, threat of job loss, etc.)	applicable in monetary form	prohibited
Money	base	applicable
Natural (buying or renting a home, providing a car, etc.)	applicable in monetary form	applicable for target agreements
Moral	prohibited	neutral
Paternalism (caring for the employee)	prohibited	prohibited
Organizational (content, conditions and organization of work)	neutral	applicable
Career, development	applicable	applicable
Participation in co-ownership and management	neutral	base

In order to study the types of labor motivation of personnel, it is proposed to conduct a sociological survey of employees whose work, according to statistical data, is more associated with dangerous phenomena at work and the possibility of violating labor protection requirements. On the basis of the received data it is necessary to make:

- distribution of respondents by type of motivation;
- selection of the most effective forms of motivational influences according to the established types of motivation;
- improving the system of external motivation of employees to ensure the reduction of injuries.

Achieving this goal is possible by selecting employees according to certain criteria when hiring, and in the course of work – the use of financial remuneration tools that take into account the personal needs of employees to comply with labor protection requirements.

4. Discussion of the Results

Currently, the management of industrial injuries takes into account a set of factors, such as external influences (noise, vibration, etc.), compliance of equipment, tools, etc. with regulatory requirements for labor protection. The reserves of these elements of the production environment in the railway industry have been almost exhausted in recent years, when significant results have been achieved in reducing injuries. The industry's decision to achieve zero injuries can be implemented on the basis of minimizing the impact of the human factor in the form of dangerous behavior of the employee, leading to employee's injury and others.

It is proposed to study the motivational environment of the company: the state of internal motivation of various categories of employees and the level of adaptation to it of the administration's actions. As an initial stage, we propose the use of motivation research methods that allow us to draw a conclusion about the rationality of the industry motivational system in relation to the focus on compliance with labor protection requirements, as well as the types and forms of external motivation for various types of employee motivation.

One of the key solutions to this problem in the future is the study of the features of modern social and labor relations, extensive research of behavioral characteristics of the contingent of employees. A comprehensive study will allow for high-quality diagnostics during employment and in the course of work, to develop motivational mechanisms of influence on employees, adapted to their real needs. When studying the behavioral characteristics of employees, it is proposed to study motivational elements not only in statics, but also in dynamics.

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